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(Continued.)

Morning session, Friday, January 2, 9.30 a. m.

PRESIDENT P. J. PARROTT: The first paper on the program will be read by Dr. W. E. Britton, entitled "A Remarkable Outbreak of *Culex pipiens*."

A REMARKABLE OUTBREAK OF CULEX PIPIENS LINN.

By W. E. BRITTON, *State Entomologist, New Haven, Conn.*

Each year, at least for three years, throughout the entire western portion of the City of New Haven, there has been an outbreak of rain-barrel mosquitoes, *Culex pipiens* Linn., beginning the latter part of July and lasting until cold weather. Through this part of the city flows West River, a small stream formed by the union of three smaller streams just above the Whalley Avenue bridge. South of this bridge the stream runs through Edgewood Park and into widening meadows which at the lower end are tide marshes.

Though the writer has resided nearly half a mile west of this river since 1904, and just east of it for six years prior to that time, he has never seen these mosquitoes in such abundance as during the past three years. It was known that their breeding place was close at hand, for rain-barrel mosquitoes do not breed in the brackish water of the salt marshes. In 1912, when all known mosquito breeding places in and near the city were drained or oiled, these mosquitoes were still a great nuisance and their presence tended to discredit the work which had been done. Many who had contributed toward the mosquito fund

complained. They had paid their good money but there were just as many mosquitoes as before.

Much searching was therefore done for rain water barrels, though a thousand of them could not have produced all the mosquitoes present. They fairly swarmed in protected corners of buildings, under verandas, and in shrubbery. They were small and entered houses through the meshes of the screens. They were innocuous during the day, but as soon as it was dark they began to sing and to bite. Unless the windows were kept closed or mosquito bars placed over the bed, a good night's sleep was impossible.

On August 5, one of my assistants, Mr. L. B. Ripley, was sent to examine all pools in Edgewood Park. He happened to dip into the edges of the main stream (West River) and obtained wrigglers, especially in the little coves and in other places where, choked by vegetation or rubbish, the water was quiet. In the middle of the stream there was no breeding; the current prevented it. Small pools under the Whalley Avenue bridge were literally alive with *Culex* larvæ.

Mr. Ripley reported the facts to me, and then the stream was examined toward the north and west. In the west branch, nearly as far as the Pond Lily Company's Dye Works, wrigglers were extremely abundant, especially along the edges and outside of the main current which was slight on account of the very low water, almost no rain having fallen in June and July. At one dip of the ladle, which holds about a gill, 200 wrigglers were taken.

It was apparent that the fish had been killed or driven from the water by the dye stuffs from the Pond Lily Company's factory, though rain-barrel mosquitoes, which often breed in strongly polluted water were able to breed in this stream. Heavy rains would probably have flushed out the stream but with the lack of rain, and the absence of fish mosquitoes took possession of the water and were breeding there literally by millions. These wrigglers clustered around stones, leaves or other objects in the water and could be seen from the banks at a distance of perhaps 15 feet; little or no breeding was found in the other branches of West River where the water was clear.

Thus the mystery had been solved and the source of the mosquito nuisance had been discovered. Up to this time the main stream had not even been suspected as a possible breeding place.

During the next few days the surface of the river, where mosquito wrigglers could be found, was sprayed with oil from a point opposite Ramsdell Street near the Pond Lily Dye Works to the Whalley Avenue bridge, a distance of nearly one and one-half miles of the winding course of the stream. Also the canal near the paper mills, and many detached breeding pools that in high water are connected with the

river were treated. The winding course of the stream, with its brush-grown banks and its rough and irregular bed, partially filled with vegetation and rubbish, made the work difficult and expensive. The entire cost of this work amounted to $125.31. Apparently these mosquitoes were a nuisance nearly a mile distant from West River.

Another interesting outbreak of rain-barrel mosquitoes which occurred in 1913 in Greenwich, Conn., was described to me in a letter by Mr. Edwin M. Skinner, president of the United States Drainage & Irrigation Co., of New York City. Just north of the village of Mianus, there is a dam six or eight feet above tide level, formerly used for furnishing power for the Palmer Brothers' gas engine plant, but now abandoned for another site where steam is used. About 500 yards north of the Palmer dam, is another dam about six feet high, where a gristmill used to stand but of which only the sluiceway and part of the water wheel remain. These dams are not used, but on account of sewage emptying into the river above and between them, they are allowed to remain rather than permit the sewage to be exposed.

A short distance above the second dam there is a mill where lap-robes and cheap plush goods are made from cow-hair and low grade wool. A cheap grade of oil is used in spinning the raw wool and cow-hair, and the product is washed with water from the river which again flows into the stream. Probably dye stuffs are also used and emptied into the river. These waste materials, together with the sewage held back by the dams, probably destroyed the fish and furnished an ideal breeding-place for rain-barrel mosquitoes. The stream flow was slight in the period of drought, and the water was stagnant and slimy and thick with wrigglers. The river is about 100 feet wide by the gristmill dam and perhaps 150 feet broad at the Palmer dam and literally filled with larvæ.

Above the woolen mill is another dam, above which the water is pure and sweet. The health officer ordered the gates lifted at this upper dam and all the wrigglers were washed into Long Island Sound the same day that they were discovered.

Howard, Dyar and Knab[1] record a similar outbreak near Urbana, Ill., where a creek is practically stagnant in late summer. At a certain point this creek receives the waste from a slaughter house, and for some distance below was so charged with decomposing animal matter that no fishes could live in it, though it contained millions of wrigglers of rain-barrel mosquitoes. Adults covered the trees and bushes along the banks, but their presence was felt only for a short distance, and few of

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[1] The mosquitoes of North and Central America and the West Indies, Vol. I, p. 1[illegible]2.

them reached the town perhaps a mile away. They continued to reproduce until cold weather.

Mr. Franklin Sherman, Jr.: It may be of interest to note that at Raleigh, N. C., during the past summer we have found quite abundantly what seems to be the yellow fever mosquito.

President P. J. Parrott: I will now call for the paper by Dr. T. J. Headlee, entitled "Anti-Mosquito Work in New Jersey."

ANTI-MOSQUITO WORK IN NEW JERSEY

By Thomas J. Headlee, Ph. D., *New Brunswick, N. J.*

About fourteen years ago the late Dr. John B. Smith began seriously to study the mosquitoes of New Jersey for the purpose of finding out how they might be brought under control. He soon developed the fact that New Jersey, in addition to the fresh water breeding species common to other states, had certain species which, breeding in the brackish waters of the salt marshes, habitually flew and were wind-carried many miles inland. All told he found 35 species of fresh water breeding mosquitoes and 5 species of brackish water breeders.

Salt Marsh Work

Of the species of salt marsh mosquito recognized by Doctor Smith, *Aedes cantator* Coq., and *Aedes sollicitans* Wlk., are really very important. The former is especially abundant in North Jersey during the early part of the season and the latter characteristic of South Jersey and of the later season broods in the north.

These two species were found to oviposit in damp mud and the eggs to remain viable for long periods. Not more than 95 per cent of the eggs laid during any one season hatch during that season; at least 5 per cent wintering over. In this way the mosquito-infested salt marshes are always abundantly stocked with eggs. Apparently eggs are always ready to hatch for in a few hours after the pools have been filled tiny wrigglers make their appearance. About eight days of warm weather are sufficient to transform to pupæ and the pupæ to give up broods of blood-thirsty adults.

Before their breeding grounds were interfered with these two species covered at times a band of shore line about forty miles wide extending from Jersey City down along the coast and around Cape May and including a considerable part of Salem County. A small area of shore in Monmouth County has always been sufficiently distant from mosquito-breeding marshes to be practically free from mosquitoes, and that part of the coastal strip exposed to strong breezes from the sea has been practically free except when the wind blew from the land.

It was early found that any meadow which was covered at frequent intervals by the tide was free from breeding while any meadow covered only at long intervals or rarely at all reached was sure to breed. Parts of the meadow cut off from tidal covering by dikes or railway grades, garbage or mud fills or parts that are so high lying that the tide only rarely covers them may be expected to breed immense numbers of mosquitoes.

It is our observation that the frequently submerged meadows are not prevented from breeding so much by the change and movement of the water as by the presence of small minnows which are commonly designated as "killifish." If the extra high tides should fill the pools of the high lying meadows with fish no mosquitoes can be found breeding in them. Of course, if the pools are left long exposed without replenishment from either tides or rains, they dry up and the fish die and when rain refills them, breed mosquitoes in enormous numbers.

Salt marsh mosquito breeding occurs not only in the pools, but under favorable conditions may go on in the coarse grasses. This type of breeding becomes possible only when the lower parts of the grass stems are submerged for a period sufficient to permit development. Of course, breeding in such spots is prevented by "killifish" when they happen to be present.

It seems to the writer that the greatest single factor in determining where mosquito breeding may occur on the salt marsh is the distribution of the "killifish." So efficient are they in the destruction of wrigglers that wherever they may be no mosquitoes can breed during the period of their residence. Furthermore, they seem possessed of the desire to penetrate the marsh as far as the water will permit and may frequently be seen nosing their way among the grass stems in water two inches deep.

The 200,000 acres of the Jersey salt marsh present all sorts of breeding conditions.

That section which lies about Newark Bay and the lower course of the Hackensack River is made up mainly of the "shut-in" and "high lying" types of meadow. Breeding originally did occur throughout this area and the swarms of mosquitoes produced inundated the cities on its borders. Of all the municipalities that suffered from that plague Newark, a city of 350,000 people, was the worst afflicted. When the flight was on, I am told, the electric lights were obscured and public meetings broken up.

The parts of these meadows into which sewage is still poured and which are without proper outlets still breed mosquitoes and today form the most serious salt marsh mosquito problem of North Jersey.

The lower course of the Hackensack River is bordered in many places by vast cat-tail areas. In such of these as do not show a rise and fall of the water and expose at no time areas of muddy bottom, the salt marsh mosquito does not breed, probably because no suitable place for egg deposition can be found. Cat-tail areas in which the muddy bottom is exposed for considerable periods breed mosquitoes in enormous numbers. The marshes along the Hackensack River breed more salt marsh mosquitoes at the present time than any other part of the North Jersey salt marsh.

That section of salt marsh which lies along the lower part of Newark Bay and the Arthur Kill is less shut in and therefore less difficult to prevent from breeding. From the Arthur Kill southward along Raritan Bay, and Shrewsbury River, the meadows are narrower and more easily drained.

The meadows of Barnegat Bay are great breeders because the tide fall is small (about 12 inches) and the opportunities for the distribution of "killifish" correspondingly poor.

The marshes between the Mullica and Great Egg Harbor Rivers are frequently swept by tides and only those parts of the meadow that join the highland and the sand strip breed.

The marshes of the Atlantic coast from the Tuckahoe River to the end of Cape May are like the preceding.

Much of the marsh of the bay shore is shut in behind a low sand strip and the natural drainage greatly obstructed, causing it to breed mosquitoes in enormous numbers.

The marshes of the valleys of the Mullica, Great Egg Harbor and the Tuckahoe Rivers are broad and apparently great breeders of mosquitoes. The marshes along the rivers and creeks opening into Delaware Bay have experienced a considerable amount of agricultural development and breed correspondingly fewer mosquitoes.

Mosquito control on the salt marsh was, according to Doctor Smith, a matter of doing away with mosquito-breeding pools and standing water generally. Ditches 10 inches wide by 30 inches deep with perfectly straight, smooth sides and proper outlets are cut through the meadows at distances such as will carry off the surface water. If the pools are not drained by this means they are tapped by spurs. Small pools are usually filled with sods taken from the ditches, and in a few years become smooth meadow. Occasionally areas of meadows are found so located that ordinary ditching is impracticable. In such cases the meadow is trenched with ditches as described and perhaps if the trenches cannot contain all the water an artificial lake is cut in the lowest part. Trenches and artificial pool are connected and the system stocked with "killifish" which are usually able to main-

tain themselves for two or three years. In this way all the water containing parts of the marsh are open to the fish or laid dry at low tide and breeding cannot occur.

In this way the salt marsh from Jersey City to Barnegat on Barnegat Bay, with the exception of certain parts of the Hackensack marshes, recently found breeding, have been rendered practically free from mosquito breeding. The state has cut most of the ditches. Much of this drainage is now being cared for and extended by the counties and the writer hopes in the near future to have all of it so handled.

The results of this drainage have been little short of marvelous. Shore properties which at certain seasons of the year were uninhabitable are now delightful summer resorts. From Jersey City to Rumson shore, property has increased five and a half million dollars and the greatest percentage of increase has taken place in the purely residential districts. In one instance the increase amounted to 300 per cent.

A very natural but rather unexpected result of the drainage was a marked increase in the yield of salt marsh hay. Fairly careful estimates show that the marsh which is drained three years or more yields 2.6 tons per acre as compared with .7 of a ton from the undrained marsh. As this hay is worth $8 a ton the drained marsh makes a yield worth consideration.

About 60,500 acres have already been ditched and 139,500 acres yet remain. The average cost of ditching does not exceed $5. Fairly careful estimates indicate that the completion of this drainage would in short time increase taxable property values by at least $26,000,000.

The Atlantic Coast of New Jersey is fitted by nature to become the playground of the East and to the end that it may become so the mosquito must go.

Doctor Smith tried several types of organization before he hit upon the one under which most of the salt marsh drainage has been carried on. First a law was enacted (1904) declaring a mosquito-breeding place a nuisance and making it the duty of local boards of health to cause its abatement. Then a law was enacted making state funds available to municipalities which desired to abate salt marsh mosquito-breeding places, providing the municipalities would themselves contribute a heavy percentage of the cost of abatement. Finding that neither of these laws brought about satisfactory progress, he secured the passage of chapter 134, Laws of 1906, in which the director of the New Jersey State Agricultural Experiment Station was charged with the duty of causing the abatement of salt marsh breeding places acting through the authority of local boards of health

and doing the work with funds appropriated by the state. One of the provisions of this act enabled municipalities active in the abatement of salt marsh mosquito breeding to obtain state aid. The entomologist was appointed by the director of the Experiment Station as his executive officer and Doctor Smith thus came to be in full charge of the work.

In some ways the work has shown certain defects in the law which must soon be modified to fit present conditions. Since its enactment the work of ditching has demonstrated the need of more police power and the enactment of a law (1912) creating county mosquito extermination commissions has brought about a relation for which there is nothing specific in the 1906 law to provide.

Inland or Local Mosquito Work

Doctor Smith's studies showed that the really important fresh water breeding species of mosquito could be roughly thrown into four groups: the house mosquito, the malarial, the swamp mosquito and the woodland pool mosquito.

The house mosquito and the species composing the malarial group winter in the adult stage in protected places, showing a strong preference for the cellars of dwellings as a place for hibernation. Eggs are laid on any stagnant or partly stagnant water and one brood follows another. These mosquitoes breed in all sorts of pools, but the malarial group is usually to be found in cleaner water. The larvæ of this group are frequently found along the grass-overgrown banks of streams. The house mosquito breeds wherever the water stands long enough for it to come through. Lot, garbage dump and roadside pools, cesspools, sewer catch basins, rain barrels and roof gutters are common breeding places for this species.

The principal swamp mosquito species—*Aedes sylvestris* Theob.—passes the winter in the egg stage at the bottom of pools and the adults are on the wing throughout the season. While not a migrant like the principal salt marsh species, a mile or two is easy and five miles are not beyond its powers. While such areas as the Great Piece Meadows of northern New Jersey produce this species in enormous numbers, the great cedar swamps of South Jersey breed few of this or any other species.

The important members of the woodland group winter in the egg state on the mud or submerged débris. The larvæ appear very early and the adults are the earliest of the really troublesome mosquitoes to get on the wing. They are most abundant during the early part of the season and cease to be noticeable as it progresses.

The *Coquillettidia perturbans* Wlk., is at once the hardest b[illegible] r and

has the most peculiar larval life of the more important species. It breeds in places that partake of the nature of a woodland pool and of a swamp. The larvæ never come to the surface for air; but remain for their entire life among the grass roots at or near the bottom of the pool.

Beginning in late April the woodland species get on the wing and continue to be troublesome to persons living near or penetrating their haunts until midsummer, when they almost cease to be noticed. When breeding places for *Aedes sylvestris* Theob., the swamp mosquito, are present it will appear with the woodland species and stay for the rest of the season.

The house mosquito usually begins to appear in troublesome numbers in late June and by the middle of July is abundant, and continues so until cold weather stops its breeding and sends it into winter quarters. We usually think of this species as migrating only a few hundred yards, but the work of the past summer has indicated that when bred over a large area in enormous numbers it infests adjoining territory for nearly or quite 2.5 miles.

Inasmuch as this fact, in the writer's belief, is being formally recorded for the first time, the proofs upon which it rests should be set forth with some care.

The entire territory included in the counties of Union and Essex was under constant observation throughout the last two mosquito-breeding seasons. With the exception of the Ebling marsh, which lies to the southeast of the City of Newark, the mosquito breeding in Essex and Union Counties was under such good control, that an expert would have to search this territory for some time before he found pupæ of fresh water breeding mosquitoes. About fifty acres of the Ebling meadow, which was waterlogged with sewage, began breeding *Culex pipiens* Linn. and *Culex salinarius* Coq., about midsummer and continued throughout the season with the exception of certain periods when extra high tides cleared the sewage out sufficiently for "killifish" to penetrate or the efforts of the Essex County Mosquito Extermination Commission resulted in the destruction of a brood.

The southern part of the City of Newark and the northern part of the City of Elizabeth exhibited a far larger number of mosquitoes (both *C. pipiens* and *C. salinarius*, but mainly the former) than did other parts of these counties. This concentration was practically coincident with the heavy breeding on these sewage-charged marshes. The pupæ were just as difficult to find in the districts heavily infested as they were in districts in which there were not enough mosquitoes

to occasion complaint. By means of a large number of night collections, made at the same hour, in the same fashion and in as nearly similar localities as the nature of the topography would permit, a zone of mosquitoes was traced from the Ebling meadows through South Newark into North Elizabeth, a distance of 2.5 miles.

Briefly stated, the proof of the *Culex pipiens* spreading from a heavy breeding area is: (1) A concentration of the species in a definite locality some distance from the breeding place; (2) absence of sufficient local breeding to explain the infestation; (3) the discovery of a zone of mosquito infestation from the great breeding place to point infested.

Soon after the house mosquito makes its appearance the malarial species develops and continues in increasing numbers throughout the breeding season.

For many years various civic bodies and associations made intermittent efforts at mosquito control, but it was not until the creation of the county mosquito extermination commissions that a really efficient local agency for mosquito work came into existence. The failure of other local agencies was due to the fact that mosquito control was only one of their objects and that they were willing to neglect it for something which, at the time, appeared to be of greater importance.

The county mosquito extermination commission act is an admirable attempt to unite in a practical fashion the local and state anti-mosquito agencies and is well calculated to secure men of proper caliber as commissioners. Under its provisions the supreme court judge presiding over the courts of each county is compelled to appoint a commission of six men, three of whom shall have been at some time connected with board of health work. These commissioners must serve without pay and each commission is charged with the duty of preparing annually a statement of plans and methods for controlling the mosquitoes within the limits of their counties and an estimate of the expense necessary thereto.

The director of the New Jersey Experiment Station is *ex-officio* member of each commission and must pass annually on each statement of plans, methods and financial estimates submitted. The director has power to modify this statement as he sees fit, but is under obligation on or before a specified date to forward the approved statement to the board of chosen freeholders of the county from which it came. On the receipt of this statement by the board of freeholders it becomes obligated to make the appropriation.

So far as the writer's experience goes, and he has become personally acquainted with all the commissions that have exhibited a desire to do something, the supreme justices have appointed a very capable and public-spirited body of men. Very wisely the commissions in

counties where public sentiment would not support mosquito work, have done nothing. Wherever the people would support work, either it has already been started or movements looking towards its beginning have been initiated.

In 1912, the year the law was enacted, Essex and Union Counties began work, with \$75,000 and \$28,000 respectively. When the law was in jeopardy in the legislative session of 1913 their legal representatives stood by it solidly and were largely instrumental in preventing its repeal or amendment.

In 1913 Essex, Union, Hudson and Atlantic worked with \$70,000, \$26,000, \$32,000 and \$26,000 respectively. Published reports of their work are available to those who are interested. During the same year Passaic, Bergen, Camden, Cape May and Gloucester Counties had small appropriations for preliminary work as follows: \$8,500, \$500, \$500, \$500 and \$50.

In all cases where funds were sufficient for the active work of protecting a whole county, the commission has proceeded to organize a force of inspectors and laborers headed by a chief inspector on whom the duty of, and the responsibility for, mosquito control falls. The county is divided into districts of such size that the inspectors can, during the breeding season, cover the breeding places every ten or twelve days. The laborers are used to eliminate such breeding places as can be destroyed. Pools are drained or filled, the margins and banks of brooks and ponds are cleared and walls made perpendicular so that fish can reach every part and consume the wrigglers.

Briefly stated, the general plan is to find all the breeding places, eliminate all of them that can possibly be eliminated by draining, filling, cleaning or stocking with fish and to oil at regular intervals all breeding places that cannot be eliminated.

Of course, the county mosquito extermination commissions take charge of the salt marshes within their limits, keeps the ditches clean and extends them as the evolution of the marsh demands.

Summary and Conclusion

The state has undertaken the drainage of the salt marsh. Already [illegible] miles of the coast have been drained with large resultant increases in property values. A law has been enected by means of which good local agencies for mosquito control have been formed and closely related to the state mosquito control work. This local agency has proved successful wherever it has had a chance to work with a full force and has obtained the support of the taxpayers. The local movement is spreading rapidly. This local agency helps to estab-

lish and keep in repair and extend the salt marsh drainage established by the state. The outlook for the early elimination of the Jersey mosquito is at the present time bright.

President P. J. Parrott: The next paper on the program is entitled "Experiments with House-Fly Baits and Poisons," by Mr. A. W. Morrill.

EXPERIMENTS WITH HOUSE-FLY BAITS AND POISONS

By A. W. Morrill, *Phoenix, Arizona*

While it is generally accepted that as a rule the most practicable means for the control of the house-fly is the prevention of its breeding, work directed against the adult insects, particularly in rural districts, must be relied upon to a considerable extent as a protection against this disease-carrying pest. There are many situations where fly traps, fly poisons and even sticky fly paper are the only practicable means of protection and many more where such means are valuable accessories to the more desirable methods of protection.

The experiments upon which this paper is based were planned with the view to securing more definite information than was available concerning the comparative attraction for the house-fly possessed by some of the many materials used and publicly recommended for use as fly trap baits or fly poisons. This information was especially needed for the determination of standards for comparison with certain commercially exploited mixtures made by secret formulæ and claimed by the promoter to be superior to all other known fly poisons and baits. While the results meet this primary object, the continuation of the experiments promises further results of practical as well as scientific interest. In these experiments the writer has been materially aided by Mr. George Acuff, crop pest inspector at Phoenix.

Unless otherwise stated the baits or poisons were exposed in watch glasses in the bottom of small dome-shaped fly traps of the style devised by Professor Hodge. This provided for the exposure of equal amounts of the materials which were being tested. The traps were placed out of doors in a row about fifteen inches apart and so far as could be determined by general observations there was no material advantage in one location over another. The period of exposure was from three to four hours during the warmest part of the day. After exposure the flies were killed by means of carbon bisulfid fumes and the number captured recorded in each case. Where the baits were poisoned, dead flies found in the bottom pan-like section of the trap

ilso counted. In one case, when formalin was used in the trap, lies outside several cages were counted and were found to rep- only 5.3 per cent of the total killed and captured alive. In her experiments those which escaped after feeding on the poison iot taken into consideration.

principal results of the cage or fly trap experiments are pre- in Table I. In order to group the different bait materials ivenience in making comparisons, wherever a combination was . an extra listing in the table has been made for each ingre- with the exception of water. Commercial formalin (40 per cent) with water at the rate of one part to ten was included in all tests except those made on one day, December 12, and this e provides a good basis for comparisons with the other materials. gures given represent the percentage of the total catch each day. ldition to the tests included in the following table several were made. In one series the following fly collections were ed: Beer, 527; sweet milk, 268; sour milk, 268; decayed banana, resh banana, 135; cheese, 107; fresh orange, 99; cane sugar, ayed apple, 26; fresh apple, 5.

test the killing effects of those substances used as poisons in trap experiments a third series was made with the poisonous posed in watch glasses outside of the traps and resting on papers litate the counting of the dead insects.

romate of potash was included with the other materials on ac- of its endorsement in a newspaper dispatch concerning a Kan- te board of health bulletin. Whether or not the substance was nended as a fly poison in the bulletin referred to the writer has scertained. It is evident, however, that it is of little value as red with formalin, cobalt and alcohol.

series of experiments was made with tanglefoot fly paper to ine whether it was practicable to increase the attraction this has for flies. Dried blood moistened with water and placed in glass near the center of a sheet attracted 465 flies as compared 4 flies attracted to a nearby sheet which was lightly sprayed with ent formalin, and 230 flies attracted to an untreated sheet. her instance a sheet of the fly paper with a small piece of banana middle attracted 363 flies, as compared with 350 attracted to having dried blood rubbed into the sticky surface, 283 attracted ntreated sheet, 266 attracted to a sheet treated with bichro- potash and 210 to a sheet treated with cobalt. In these four ere substances were added an equal area near the middle sheet was treated in each case. Dried blood moistened with d decayed banana were tested by treating a square inch of

TABLE I

ATTRACTIVENESS OF FLY BAITS AS INDICATED BY PERCENTAGES OF TOTAL FLIES [illegible]

	Date of test, December, 1913	10	12	17	18	22
	Vinegar Group:					
1	Vin. (plain)	4.0				
2	Vin.-sugar	36.5				22.0
3	Vin.-bread	25.0				
4	Vin.-form. (10-1)	8.6				
5	Vin.-sugar-water (1-1-1)					19.5
6	Vin.-water-dried blood (1-1-1)					7.5
	Formalin Group:					
7	Form. (40%)	.1			11.0	
8	Form.-bread	15.0			0.	
9	Form.-water (1-20)	5.4			.1	
10	*Form.-water (1-10)*	*.6*		*3.5*	*3.0*	*1.0*
11	Form.-water (1-5)	1.0			1.2	
12	Form.-water-sugar (1-10-1)				4.1	3.5
13	Form.-water-bread (1-10)	3.3			3.4	
14	Form.-water-bran (1-10)				2.8	
15	Form.-water-beer (1-5-5)				32.9	10.3
16	Form.-water-milk (1-5-5)				3.9	11.3
17	Form.-water-dried blood (1-5-5)			21.4	8.4	3.5
18	Form.-beer-milk (1-5-5)				28.7	
19	Form.-water-bichr. of pot. (1-20-1)				.6	
4	Form.-vinegar (1-10)	8.6				
	Alcohol Group:					
20	Alc. (95%)					
21	Alc.-water (1-10)			11.0		6.2
22	Alc.-water (1-20)		.4			1.7
23	Alc.-cane-syrup (1-20)		3.4			
24	Alc.-water-bran (1-20)		26.0			
25	Alc.-water-cobalt (1-20-1)		5.5			
26	Alc.-water-bichr. of pot. (1-20-1)		2.1			
27	Alc.-water-sugar (1-20-1)					8.0
28	Alc.-water-beer (1-10-10)					3.4
29	Alc.-water-dried blood (1-20-1)					2.0
30	Alc.-water-bread (1-20)					
31	Alc. (95%)-bread					
	Bichromate of Potash Group:					
19	Bichr. of pot.-form.-water (1-1-20)				.6	
26	Bichr. of pot.-alc.-water (1-1-20)		2.1			
32	Bichr. of pot.-water (1-20)			.2		
	Cobalt Group:					
25	Cobalt-water-alc. (1-20-1)		5.5	4.6		
33	Cobalt-water (1-20)					
34	Cobalt-water-bread (1-20)					
35	Cobalt-water-dried blood (10-10-1)			3.0		
	Milk Group:					
36	Milk (sweet)		7.6			
37	Milk (sour)		3.8			
16	Milk-water-form. (5-5-1)				3.9	11.3
18	Milk-bread-form. (5-5-1)				28.7	
38	Milk (sweet)-bread					
39	Milk (sour)-bread					

TABLE I.—*Continued*

Date of test, December, 1913	10	12	17	18	22	23	24
Beer Group:							
Beer-water-form. (5-5-1)				32.9	10.3		
Beer (fresh)		48.5					
Beer (stale)		3.8					
Beer-milk-form. (5-5-1)				28.7			
Beer-alc.-water (10-1-10)					3.5		
Bread Group:							
Bread-water							13.5
Bread-vinegar	25.						
Bread-formalin (40%)	15.			0			8.4
Bread-form.-water (1-10)	3.3			3.4		14.5	17.4
Bread-milk (sweet)						17.1	
Bread-milk (sour)						7	
Bread-alc.-water (1-20)						33.5	17.2
Bread-cobalt-water (1-20)						7.3	
Bread-alc. (95%)							17.4
Dried Blood Group:							
Dried blood			0				
Dried blood-water			14.6				2.8
Dried blood-form.-water (5-1-5)			21.4	8.4	3.5		
Dried blood-water-cobalt (10-10-1)			3.0				
Dried blood-alc.-water (1-20)					2.0		
Dried blood-vin.-water (1-1-1)					7.5		
Animal Matter Group:							
Flies (dead)			0.				
Meat (fresh)			2.4				
Meat (decomposed)			3.0				
Fish (fresh)			4.5				
Fish (decomposed)			2				
Dried blood			0.				
Dried blood-water			14.6				
Sugar Group:							
Sugar-vinegar (1-1)	36.5				22.		
Sugar-form.-water (1-1-10)					3.5		
Sugar-vin.-water (1-1-2)					19.5		
Sugar-alc.-water (1-1-20)					8.0		
Water							.9
Number of cages	10	9	12	13	13	10	11
Total number flies captured	2,844	1,011	458	3,291	1,537	740	999

...paper surface with each and comparing the two treated with two untreated sheets. This resulted in the capture of 86 flies on the sheet treated with banana, 37 on the sheet treated with dried blood and 34 and [illegible] respectively on the two sheets not treated.

The writer's attention was called to the apparent difference in the attractiveness of old and new wire fly traps by Mr. Acuff. An old fly trap was tested twice in comparison with a new trap of the same kind. With fresh milk as a bait the new trap captured 13 flies

and the old trap one fly. With dried blood moistened with water the new trap captured 28 and the old trap 12. Combined, the new trap captured 41 and the old trap 13 in the two tests.

TABLE II

Date, December, 1913	Material used	Flies killed	[illegible]
17	Cobalt (1) water (20) and bread	101	47
17	Formalin (1) water (10) and bread	78	[illegible]
17	Cobalt (1) water (20) and dried blood	20	[illegible]
17	Bichromate of potash (10 dms.) water (2 oz.) and bread	16	[illegible]
18	Formalin (1) water (10)	259	[illegible]
18	Alcohol (1) and water (20)	253	[illegible]
18	Cobalt (1) and water (20)	104	16.5
18	Bichromate of potash (10 dms.) and water (2 oz.)	13	[illegible]

Conclusions from the Experiments

Vinegar in itself is an excellent bait for a fly trap but when used with sugar or bread its attractiveness to flies is greatly increased. Equal parts of vinegar, sugar and water appear to be approximately as attractive as equal parts sugar and vinegar. An attractive combination poisonous to flies can be made with formalin and vinegar but further tests are necessary to determine the best proportions.

Formalin (40 per cent) differs greatly on different days in its attractiveness to flies. This variation is evidently not due directly to temperature conditions, and it suggests the possibility of the flies themselves differing from day to day in the degree of the sensitiveness of the sensory organs. Formalin, as is well known, makes an excellent fly poison when combined with other substances. The usual dilution of the commercial or 40 per cent formalin at the rate of about one part to about ten parts of water seems to be as good as at any other rate. Beer, milk and bread, in the order named, are excellent materials to use with formalin, increasing its attractiveness many times. The addition of sugar increased the attractiveness of the formalin solution but not to a satisfactory degree.

Commercial alcohol (95 per cent) and water at the rate of one to 20 appears from the experiments to be of about equal value with formalin and water mixed at the rate of one to ten, both as to attractive power and killing effects. The addition of sugar to the alcohol mixture gave a more marked increase in the attractive power than did the addition of sugar to the formalin mixture. Beer and alcohol did not make an attractive mixture, while the addition of bread to alcohol and to alcohol mixtures increased the attractive power

even greater than did the addition of bread to formalin and to formalin mixtures.

Bichromate of potash solutions gave practically no results either in the tests of its attraction or of its poisonous qualities.

Cobalt gave variable results in the tests but appeared rather peculiarly attractive when used with bread and in one instance exhibited better killing effects than formalin.

Sweet milk without addition of other material seems to have little if any advantage over sour milk in the point of attractiveness to flies. Combined with bread sweet milk was strikingly attractive but not so much so as were formalin or alcohol mixtures used with bread.

Beer was found to be a very attractive bait for flies under certain conditions. As already mentioned it combines readily with formalin but not with alcohol. Fresh beer, contrary to the common idea, was found to be far more attractive than stale beer.

Bread added greatly to the attractiveness of various liquid fly foods and poisons.

Wheat bran was found by the experiments here recorded and others to be inferior to bread as a fly bait.

Overripe or decayed banana was found to be superior to ordinary ripe banana and to both good and decayed oranges and apples as a fly bait.

Commercial dried blood moistened with water was found in the experiments to have attractive value greater than fresh and decomposed meat or fish. It is noteworthy that decomposed fish was found to be much less attractive to house-flies than fresh fish. Blue bottle flies and other species of the so-called flesh or meat flies were attracted to these "animal matter" baits, but only the true house-fly is herein considered.

Contrary to expectations cane syrup and sugar and water were found to have relatively low attractive value when used without other materials.

The value of sticky fly paper was very materially increased by exposing small amounts of attractive baits on the center of each sheet. The tests show that a thin slice of overripe or decayed banana makes an inexpensive and effective bait for this purpose.

Mr. T. J. Headlee: In the house-fly campaign in the City of New Brunswick, N. J., "Hodge Fly traps" were placed on garbage cans. Very few house-flies were caught but large numbers of green and blue bottle flies were secured. We experimented with various kinds of bait. Milk and bran bait is the best we have found, but we did not

go into such extensive tests as have been outlined by the speaker. Large cylindrical traps used on the college farm caught immense numbers of flies. Although we caught twelve to fifteen quarts each week on the college general farm, we could not discover that the destruction of this number produced any appreciable diminution. It seems to us that traps are almost useless in such campaigns, and that the elimination of breeding places is all-important. In the city fly control work this must be brought about by the establishment and maintenance of a good sanitary police force.

Mr. J. G. Sanders: Of all the baits I have used for house-flies, the best I have discovered is milk and formalin. It is more effective if milk is allowed to sour before the formalin is added.

Mr. Z. P. Metcalf: In my laboratory I have a sink about twelve feet long from which the water does not drain properly. Vessels containing formalin solution are often exposed in this room and on days when the sink becomes dry the flies drink the formalin from these vessels and are killed. When the water remains in the sink they do not touch the formalin and no mortality results. In West Raleigh the people are able to control the house-flies by not giving them access to water.

In another room where there was a drinking fountain flies were very troublesome and it was impossible to kill them with the milk and formalin mixture. After the fountain was removed large numbers were destroyed by using this mixture.

President P. J. Parrott: We are greatly favored this morning by the presence of Dr. L. O. Howard who will present the next paper, entitled "The Education of the Entomologist in the Service of the United States Department of Agriculture."

THE EDUCATION OF THE ENTOMOLOGISTS IN THE SERVICE OF U. S. DEPARTMENT OF AGRICULTURE

By L. O. Howard

This paper has no connection with the excellent series of papers presented before this Association on the training of an economic entomologist, since it does not in any way attempt to point out the necessary lines of education for one entering the government service. It is simply an effort to indicate the educational institutions at which the men who have entered the service received their training. I have the facts about 260 of these individuals, and, entering into the matter without any preconception of the result, I must confess to much surprise at the great number of institutions represented (64 American

colleges and universities) and at the distribution of the individuals among these institutions.

In the history of the service there have been but four heads. Glover, the first entomologist, received no university education, but was trained in art at Munich, just as was Frederick Knab of the present Bureau force at a much later date. Riley, the second incumbent of the office, was sent as a young boy from England to boarding schools in France and in Germany (at Dieppe and Bonn) but came to this country at the age of seventeen without having any real college training. Comstock, the third entomologist, worked his way through Cornell University, graduating with the class of 1874. The present incumbent was one of Comstock's earliest students and graduated with the class of 1877. Comstock held the office for two years only, and was succeeded in 1881 by Riley, who also preceded him, the present incumbent succeeding Riley in 1894.

The growth of the service was comparatively small down to 1900, and it is only within the last dozen years that there have been great additions to the force.

In the tabulation which I have made I have taken into consideration only those men of sufficient scientific attainments to be capable of good research work, and have not included men like Osborn, Hine, Bruner, Newell and others who, while holding other positions, have been salaried collaborators of the Bureau of Entomology. The following tables give the colleges in which these men studied. It will be noticed that the Massachusetts Agricultural College and Cornell University have the largest representations, the Ohio State University coming third, and the University of Colorado fourth. It should be stated that all of the men indicated by the tables have come together in the Bureau on the strength of their qualifications and their availability. When a good man could be engaged, the question as to what college or what section of the country he might come from has had very little weight, except that on certain special investigations in certain parts of the country, where men were available who understood local conditions and who knew the local people, these have been engaged. Thus 11 out of the 20 men engaged on the scientific aspects of the moth work in New England have studied at the Massachusetts Agricultural College, some California men have been engaged for California investigations, some from Utah and neighboring states for the alfalfa weevil and some southern men for the cotton boll weevil and other Southern insect problems. The United States Civil Service Commission now furnishes most of the men through its examinations and these are held all over the country. The papers are marked without personal knowledge of

the individual or of the college at which he has been trained, and the selections are therefore perfectly unbiased.

The teaching of entomology at Cornell and at the Massachusetts Agricultural College was begun at an early date; these departments of these institutions have been well supported, and these facts account in the main for their larger representation on this list. The University of Illinois is represented by but five, yet this does not mean that Forbes and his assistants have not been training many good men. Professor Forbes's activities have been so extended that he has been able to employ himself most of his best graduates, while many others have gone out into college and experiment station work.

It will be noticed that Harvard has been represented by seven. Two of these were from the early days of Doctor Hagen, namely, H. G. Hubbard and B. P. Mann; a third, P. H. Timberlake, took post-graduate work at Harvard after graduation from Bowdoin; a fourth, E. S. G. Titus, took his doctorate under Wheeler of the Bussey Institution quite recently, the fifth, R. W. Glaser, is now at work at the Bussey Institution on insect diseases and is studying for the Bureau the wilt disease of the gipsy moth, and the remaining two, Messrs. G. E. Clements and W. S. Munro went from Harvard to the Yale Forest School before entering the service. Now that Wheeler is at the Bussey Institution, it is safe to predict that the services of men from Harvard will be sought for by the government and the states in the future.

It is shown that twelve men have studied at European institutions of learning, and also that eighteen have, like Glover and Riley, had no college education. It is especially noticeable with those who have not been to college that many of them seem not to have suffered in the least from the lack of college training, since this category includes such leaders as F. M. Webster and A. D. Hopkins, such excellent systematists as D. W. Coquillett, W. H. Ashmead, C. H. T. Townsend and O. Heidemann, and such capital observers as T. Pergande, H. S. Barber, A. Koebele, J. D. Mitchell and F. C. Pratt.

Several of the men have studied at more than one college and in such cases he is credited as a unit to each of the colleges.

The leaders of the different sections of the work of the Bureau of Entomology are distributed as follows: Marlatt, now chairman of the Federal Horticultural Board, in addition to ranking next to the chief in the Bureau, graduated from the Kansas State Agricultural College; Webster and Hopkins, as has just been pointed out, educated themselves; Chittenden graduated at Cornell; Quaintance received his bachelor's degree from the Florida Agricultural College, his master's degree from the Alabama Polytechnic Institute, and later took post-

graduate work at Cornell; Hunter received both his bachelor's and master's degrees from the University of Nebraska; Phillips took his bachelor's degree at the Allegheny College and his doctorate at the University of Pennsylvania; Burgess is a Massachusetts Agricultural College man.

A special word of commendation should be said of the six able men who have come into the service from the Ontario Agricultural College at Guelph, Canada.

The occurrence on the list of five men from Yale might at first sight seem strange. One of them, C. R. Dodge, was Glover's only assistant in the seventies, and graduated from Yale in the class of 1874. The other four are readily accounted for by the fact that they attended the Yale Forest School and are engaged in forest insect investigations.

Those who have had any experience with the U. S. Civil Service Commission and the laws which govern it will understand very well what is meant by state apportionment, and it often happens that the government is unable to get the services of the men who have passed the highest in examinations, owing to the fact that the states from which they come have their quotas in the service already filled. From every viewpoint except the one of practical politics this is unfortunate. It may be granted, however, that so far as the entomological service is concerned it has not worked very badly, and it is true that the man who passes the best examination is not necessarily the best man in, say, a field laboratory.

I remember once in the early days of the investigations of the cotton boll weevil I was asked by a member of the Committee on Agriculture of the House of Representatives "Why do you not employ Southern men on this investigation—men familiar with the cotton crop and with everything connected with it?" My reply was to the effect that the Southern States did not educate men in entomology. That condition, however, is changing, and the following statement of the geographic distribution of the men and the colleges which they represent will indicate that there is a pretty fair representation on the force of all sections of the country. The statement is as follows:

From colleges in the Eastern States	113
From colleges in the Central States	63
From colleges in the Western States	31
From colleges in the Southern States	23
	230

It will be readily understood that with some of the institutions like Be[illegible] Bucknell, Bowdoin and Dartmouth colleges and some of the others the men did not go to them for training in entomology, but for a

general education, their real training having come from outside interest in the subject and from experience after joining the Bureau force. And this suggests the truth that, no matter how sound a man's college training has been, he begins to learn the things that count most only after he has got out into the government service or into that of one of the states. There is room for improvement in courses in entomology in most of our institutions, and our teachers in entomology, as in other branches, notably in the thirty-seven different kinds of engineering science, should constantly study the markets for the brains of the men they are training. This is an important reason why these meetings of ours, not only of the Association of Economic Entomologists, but of the great body of scientific and practical men who come together each year under the auspices of the American Association for the Advancement of Science, are so valuable, since they bring the teachers and the laboratory men and the field men together; and if the curricula of educational institutions are not frequently changed as a result of information gained at these meetings they should be.

The time is coming before many years when the best education even in economic entomology will be gained only by supplementary traveling scholarships. Down to the present time Dr. Andrew Carnegie, among his many great benefactions to humanity, has been responsible for the only traveling scholarships of this kind. Through the Central African Research Committee and the Imperial Bureau of Entomology he has brought to this country from England Messrs. A. Rutherford, E. H. Strickland, G. H. Grosvernor, C. W. Mason, M. A. MacGregor and A. H. Ritchie, and from British Guiana, Mr. G. E. Bodkin. Through the writer, he has brought over Dr. K. Escherich from Germany and Dr. Paul Marchal from France. All of these have come to America because of American prominence in this work of ours. None of us have been sent to other countries to study economic entomology because we have in general the best teachers at home. But the time is coming when other countries will come to the front in this direction and when our most promising young men will be sent to foreign teachers to round out and complete their training.

When last summer, with Marchal, I visited the Bussey Institution of Harvard, Cornell, Chicago, Illinois, California, and Stanford, I was enormously impressed by the great advantages which the student of these days has over the student of twenty years ago, but it is certain that, great as these educational advantages in our line are today, those of tomorrow will be vastly greater.

Nevertheless we must look at Riley and Hopkins and Webster, and conclude that while education educates, it's the man who achieves.

COLLEGES ARRANGED ALPHABETICALLY SHOWING STUDENTS WHO HAVE SERVED IN THE BUREAU OF ENTOMOLOGY

Alabama Polytechnic Institute	2
Allegheny College	2
Beloit College	1
Bowdoin College	1
Bucknell College	1
Clark University	2
Clemson College	1
Colorado State Agric. College	10
Columbia University	2
Connecticut Agric. College	1
Cornell University	26
Dartmouth College	1
Delaware Agricultural College	1
Florida Agricultural College	2
Harvard University	7
Iowa State Agricultural College	1
Jefferson Medical College	1
Johns Hopkins University	1
Kansas State Agricultural College	5
Kentucky State University	1
Maine State College of Agriculture	1
Maryland Agricultural College	4
Massachusetts Agricultural College	36
Michigan Agricultural College	7
Mississippi Agricultural College	3
New Hampshire Agricultural College	2
New Jersey Agricultural College	1
North Carolina Agricultural College	1
Ohio State University	17
Ohio Wesleyan University	1
Oklahoma Agricultural College	1
Oregon Agricultural College	6
Pennsylvania State College	5
Pomona College	2
	156

Forward	156
Randolph-Macon College	1
Stanford University	7
Texas Agricultural College	2
University of California	1
University of Chicago	2
University of Colorado	1
University of Idaho	2
University of Illinois	5
University of Indiana	1
University of Iowa	4
University of Kansas	5
University of Louisiana	2
University of Michigan	1
University of Minnesota	2
University of Nebraska	7
University of Montana	1
University of Nevada	1
University of North Dakota	1
University of Pennsylvania	6
University of South Dakota	1
University of Tennessee	2
University of Texas	2
University of Utah	3
University of West Virginia	2
University of Wisconsin	1
Utah Agricultural College	2
Virginia Polytechnic Institute	4
Washington State University	2
Washington University (St. Louis)	1
Yale University	5
American institutions	233
Foreign institutions	12
No colleges	18
	263

Colleges Arranged in Numerical Order of Representation in the Bureau of Entomology.

Massachusetts Agricultural College	36
Cornell University	26
Ohio State University	17
Colorado State Agricultural College	10
University of Nebraska	7
Harvard University	7
Michigan Agricultural College	7
Stanford University	7
Ontario Agricultural College	6
University of Pennsylvania	6
Kansas State Agricultural College	5
Pennsylvania State College	5
University of Illinois	5
University of Kansas	5
Yale University	5
Maryland Agricultural College	4
University of Iowa	4
Virginia Polytechnic Institute	4
Mississippi Agricultural College	3
University of Utah	3
Alabama Polytechnic Institute	2
Allegheny College	2
Clark University	2
Columbia University	2
Florida Agricultural College	2
New Hampshire Agricultural College	2
Pomona College	2
Texas Agricultural College	2
University of Chicago	2
University of Idaho	2
University of Louisiana	2
University of Minnesota	2
University of Tennessee	2
University of Texas	2
University of West Virginia	2
Utah Agricultural College	2
Washington State University	2
	206

Forward	206
Beloit College	1
Bowdoin College	1
Bucknell College	1
Clemson College	1
Connecticut Agricultural College	1
Dartmouth College	1
Delaware Agricultural College	1
Iowa Agricultural College	1
Jefferson Medical College	1
Johns Hopkins University	1
Kentucky State University	1
Maine College of Agriculture	1
New Jersey College of Agriculture	1
North Carolina College of Agriculture	1
Ohio Wesleyan University	1
Oklahoma Agricultural College	1
Randolph-Macon College	1
University of California	1
University of Colorado	1
University of Indiana	1
University of Michigan	
University of Montana	1
University of Nevada	1
University of North Dakota	1
University of South Dakota	1
University of Wisconsin	1
Washington University (St. Louis)	1
	233
Foreign institutions	12
No college	18
	263

PRESIDENT P. J. PARROTT: The next paper will be presented by Dr. C. Gordon Hewitt, entitled "Further Observations on the Breeding Habits of the House-fly and its Control."

FURTHER OBSERVATIONS ON THE BREEDING HABITS AND CONTROL OF THE HOUSE-FLY, MUSCA DOMESTICA

By C. GORDON HEWITT, D. Sc., F. R. S. C. *Dominion Entomologist, Ottawa*

The following account of certain investigations carried on during the past summer (1913) is of a preliminary character. It was considered desirable to communicate to the Association an interim report of this nature, primarily with a view to drawing the attention of other workers to the need of experimental work along similar lines. In so important a public problem as the control of house-flies, it is most desirable that the assistance of as many workers as possible should be enlisted, especially in a country containing so varied climatic, economic and other conditions.

Probably no entomological subject is now more popularly discussed than house-fly control, and as one who has, during the past eight years, devoted more attention to this subject than to any other entomological problem, I am bound to confess that in the matter of control measures there is still much to learn and we are far from having solved the basic problem of control, namely, the prevention of breeding. I am not referring particularly to the question of the construction of fly-proof receptacles for stable-refuse and other fly breeding substances, but to the use of insecticidal substances under conditions which prohibit the taking of other precautions and render desirable the adoption of additional remedial measures.

It is in regard to control measures under rural conditions that we are most deficient in knowledge. For many reasons the prevention of breeding under urban conditions is, I believe, more subject to control. Civic authorities can insist on stables being constructed on certain approved lines, on the segregation of stables, a most important policy, on stable-refuse and garbage being stored according to prescribed methods, on the periodic removal of these breeding substances and so forth. All of which tend to reduce the problem to simple terms, though I should be the last to deny the inherent difficulties. Under rural conditions, however, the problem is different and it should be hardly necessary to indicate the importance of house-fly control in the country. One aspect alone, namely the possibility of milk contamination, and our milk supplies will always originate in the country, is sufficiently serious to warrant the greater attention to fly control

measures in rural districts. In such districts conditions are not so easily controlled by health and other authorities, though very efficient control could be established by means of regulations governing the supply of milk to cities and towns requiring the inspection of farms and dairies. Nevertheless, we are faced with the problem of house-fly control under rural conditions and we must examine it.

The farmer, if he does not store his stable refuse in fly-proof receptacles, will probably require a cheap and efficient insecticide. In addition he will usually ask what effect will the application of an insecticide have on the fertilizing of the manure. These are the problems we are called upon to solve and it was with a view to obtaining further data on the comparative value of insecticides in the control of house-flies under rural conditions and the effect of such treatment on the fertilizing properties of the manure that the special investigation which I commenced during the past summer was undertaken.

A number of investigators have previously carried on experiments along these lines, among whom may be mentioned Howard at Washington, Forbes in Illinois, Herms in California, and Newstead in England, but I feel sure that they would be the first to agree with my contention that the problems, as I have briefly indicated them, are by no means solved and that much more experimental work is required. There are two distinct problems which the study of the comparative value of the insecticides involves, namely, their insecticidal value and their effect on the fertilizing properties of the manure. The latter problem must of necessity be studied largely if not entirely by the agricultural chemist, and as the study of the comparative manurial values has not been undertaken in the course of the past season's work but will be prosecuted, I hope, next year, I shall devote myself to a consideration of the first of these problems. I would impress upon other workers, however, the great desirability of studying the effect of the insecticides on the manure as the farmer requests information on that point.

In passing, I should not omit to refer to a frequent recommendation which is made to farmers as a means of prevention, namely, that the manure should not be stored in heaps but should be carted away immediately and spread. Where this can be done it is, of course, the simplest method of procedure; apart from that fact it has the additional advantage of being the best policy from the point of view of manurial values. Extensive experiments in Canada and the United States have demonstrated the advantage of spreading the manure over piling it. This, however, is by the way.

In order to judge the relative values of different insecticides it is necessary to decide upon a means of comparison. In making this

choice there are two alternatives, namely, either to count the number of dead as compared with the living larvæ in the treated manure, or to count the flies emerging after treatment. In previous work of this nature the former standard has been employed as a rule. It has a serious defect, however, namely, that the portion of treated manure selected, presuming a fair amount has been treated, may not be typical of the whole; in fact my experiments have shown that it would be extremely difficult if not impossible to select an average sample. To this point I shall refer later. In my opinion the only satisfactory basis of comparison is the number of adult flies which emerge from the whole amount of the manure treated. The experiments about to be described were arranged with that object in view.

Methods

It was decided to use a cubic yard, that is twenty-seven cubic feet of manure, as the amount of manure to be treated and the number of flies emerging from a cubic yard of untreated manure would be used as the standard of comparison. As experience demonstrated the actual quantity of manure was a little less than twenty-seven cubic feet owing to the sinking of the manure. In spite of the cubic yard being heaped up it settled to a depth at the sides of two feet six inches on the average, thus giving approximately twenty-two cubic feet of manure after settling.

To contain the manure wire enclosures (Plate 9) were constructed of strong one-inch galvanized poultry wire supported by wooden stakes and cross-pieces at the top which was open. The stakes were driven into the ground until three feet of wire remained above ground.

The horse manure, which was mixed with an average quantity of straw used in the stables, was carted straight from the stable and thrown into the wire enclosures and trodden down as it was thrown in to obtain a fairly compound and typical manure heap. The top of the pile was made higher than the enclosure to allow for the settling which took place in spite of the packing. The sandy soil was piled up around the base of each heap to provide accommodation for the pupation of the larvæ.

Six such piles of manure were used. In some cases they were left for two days to allow the flies to oviposit, in other cases, for example, where chloride of lime was used, they were treated immediately after the enclosures had been filled. After exposure for two to three days after treatment with the insecticides the heaps were covered with wooden covers as shown in plate 9. These covers were made sufficiently large to leave a space of about six inches all around the wire enclosures when they were covered. Two holes were provided in the top for wire balloon fly traps to capture the flies as they emerged.

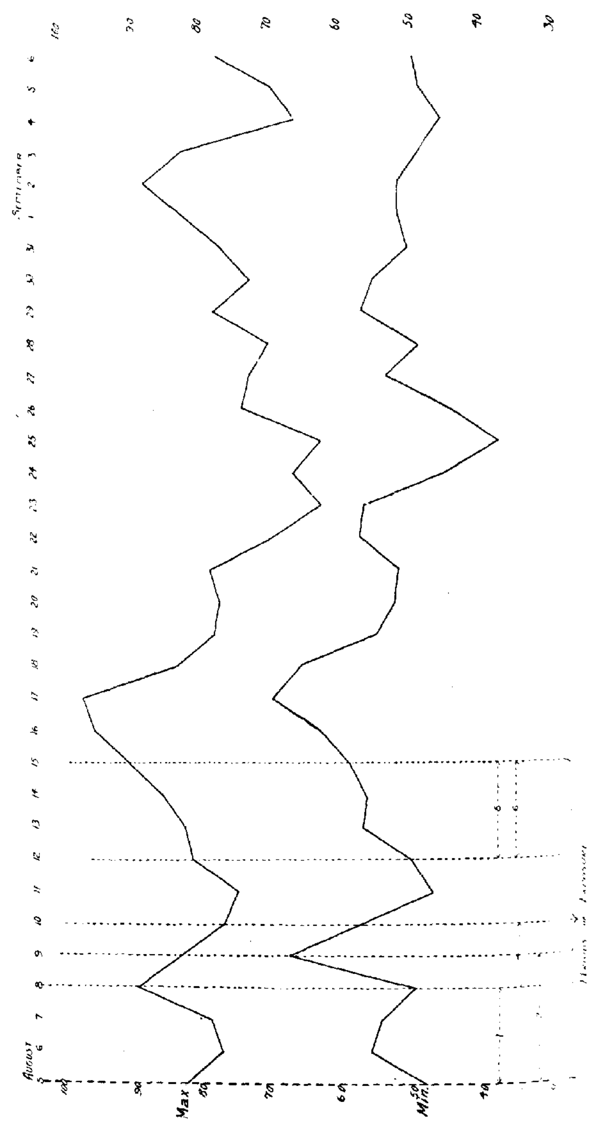

Fig. 20. Maximum and minimum temperature during experiments.

It was not long before experimental results were obtained but these were not of the nature which I had planned to secure. In spite of the fact that the lower edges of the wooden covers had been sunk in trenches and the soil piled round, it was found that some of the larvæ tunnelled beneath the cases and pupated in the soil piled outside the case with the result that flies began to emerge outside where provision had to be made for them. In this way a few hundred flies escaped from each of the first two or three experiments, but not sufficient, I think, to materially affect the general results. Accommodation was immediately provided for the reception of these wanderers by covering the piled up soil round the outside of the wooden case with cheese cloth, as shown on plate 9 and the exit at the front led into a wire balloon fly-trap. After this no further trouble was experienced, but the circumstance threw additional light on the pupating habits of the larvæ to which I shall refer later (see Pupation).

The emerging flies were caught in the wire traps and were counted once or twice daily as circumstances demanded. Heat was used as the means of killing them. I wish to acknowledge my indebtedness to my assistants Mr. Germain Beaulieu, and Mr. Sydney N. Lord who carried out the work of counting the individual flies.

Experiments

Six series of experiments, Nos. 11 (1) to 11 (6) were carried out and the following is a summary of the series:

Exp. No. 11 (1). Untreated. Manure piled August 5th. Covered August 8th on which date second stage larvæ were found very numerous immediately beneath the surface.

Exp. No. 11 (2). Iron sulphate treatment. Manure piled August 5th. Pile sprayed with iron sulphate (2 pounds in 1 gallon of water) on August 8th, on which date many second stage and a few third stage[1] larvæ were found in surface layer. Four gallons were applied to the top and sides of heap with a hand spray pump using a coarse nozzle. The vertical sides of the heap made it more difficult to thoroughly drench the manure on the sides. Pile covered August 9.

Exp. No. 11 (3). Chloride of lime; surface treatment. Manure piled August 8th. After piling, 3 pounds of chloride of lime were sprinkled over the top and sides of the heap, the sprinkling of the vertical sides was difficult and not entirely satisfactory. On August 9th, [illegible] third stage larvæ were found within an inch of the surface

[1] The manure in each case lay in the stable for two or three days before being hauled out and piled in the wire enclosures a certain number of eggs were deposited before piling, in spite of the stable being screened. But this fact would not vitiate the results of these experiments.

immediately beneath the chloride of lime in spite of a thunderstorm and heavy rain which should have carried the chloride of lime in solution through the upper layers. Covered pile same day, August 9.

Exp. No. 11 (4). Zenoleum treatment. Manure piled August 8th. August 9th larvæ in third stage were found very numerous immediately below the surface of pile. Sprayed with zenoleum (ounces to 1 gallon of water) same date, using 4 gallons of the solution. Larvæ immediately beneath the surface were killed and about 20 minutes after spraying larvæ were found emerging on to the top of the manure, no doubt to die. An hour after the heap had been sprayed torrential rains fell and as a result the dilution of the insecticide would probably be affected. Pile covered August 10th.

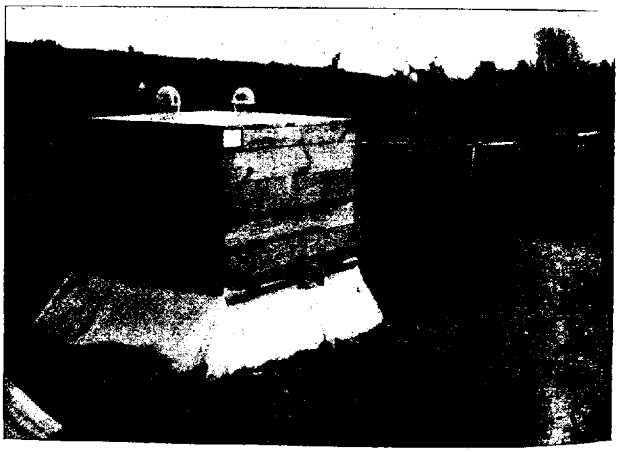

Fig. 21. Covered and uncovered manure piles used in the experiments

Exp. No. 11 (5). Chloride of lime; mixed treatment. Manure piled August 12th. As it was being thrown in the enclosure chloride of lime was lightly scattered over the top and on the sides, 4½ pounds of the chemical being used on the cubic yard of manure. This manure had lain in the stable from 1 to 3 days. Pile covered August 15th.

Exp. No. 11 (6). Kerosene emulsion treatment. Manure piled August 12th. On August 15th third stage larvæ found in upper layers. Pile sprayed same day, August 15th, with kerosene emulsion 1 in 9 strength; 4½ gallons used for the whole pile. This pile contained a little more straw than other piles. Pile covered August 15th.

Emergence of Flies

The following table summarizes the results of these experiments which have been arranged in order according to the number of flies emerging from the various piles.

EXPERIMENTS WITH LARVICIDES

Treatment	Number of Flies Emerged		Total	Experiment Number
	Top Cages	Bottom		
Untreated	8,729	4,603	13,332	11 (1)
[illegible]	229	7,811	8,040	11 (4)
Iron Sulphate	5,546	2,304	7,850	11 (2)
Chloride of Lime (surface)	857	5,086	5,943	11 (3)
Chloride of Lime (mixed)	901	3,726	4,627	11 (5)
Kerosene Emulsion	832	2,649	3,481	11 (6)
	17,094	26,179	43,273	

From the foregoing experiments kerosene emulsion appeared to be the most effective insecticide. I am inclined to believe, however, that the greater proportion of straw in this experiment, No. 11 (6), affected the results, and I should be inclined to prefer the chloride of lime treatment pending further results, especially as kerosene emulsion is considered, I believe, by chemists to affect the manurial values of the stable refuse.

These preliminary results, however, are not given for the purpose of drawing conclusions as to the best insecticide, but rather to indicate a method whereby such results may be obtained.

Pupation

Among the miscellaneous observations made during the past season's work, the following may be mentioned: It was found that the mature larvæ generally left the manure heap to pupate and buried themselves in the sand some distance away from the heap. That the majority of the larvæ travelled some distance before pupating is demonstrated in the following table in which it is seen that in the aggregate a greater number of flies were captured in the *bottom* cages, that is, the cages attached to the cheese cloth outside the wooden covers, in which cages the flies emerging from pupæ outside the wooden covers were captured.

In the cages on the top of the wooden covers, referred to as the top cages, the flies emerging from pupæ within the sides of the wooden covers were captured and these were less in number than the flies emerging from pupæ outside the wooden covers.

Larvæ were found pupating at a distance of two feet from the manure pile and at a depth of nine inches.

Temperatures of Manure and Their Significance

In the course of these experiments some significant observations were made on the temperature of the manure piles. The heating of the freshly piled manure is a matter of common knowledge and observation, but I have not seen any reference to its relation to the breeding of house-flies beyond the general statement that the higher temperature accelerated the development which my own experiments carried out some years ago under controlled incubator conditions demonstrated. Newstead found that at 100° F. the larvæ were uncomfortable and left the manure. In incubator experiments I found that a temperature of 104° F. was too great for the larvæ and anything above that roasted them alive.

If we examine the temperature of a pile of manure taken at a time when it is fresh, attractive to flies and inhabited by larvæ, the results are somewhat surprising and significant. The following are the temperatures which were taken in connection with two of the experiments:

Expmt. No.	11 (1).	11 (4).	11 (5).
Date	August 8.	August 9.	August 15
Length of time manure exposed	3 days.	2 days.	2 days
Atmospheric conditions	Sunny, cool wind.	Oppressive, alternately sunny.	Oppressive sunny alternately.
Air temperature	86° F.	78° F.	103° F.
Temp. on surface of manure	97° F.	87° F.	—
Temp. 1 in. below surface	—	106° F.	—
Temp. 4 in. below surface	156° F.	145° F.	—
Temp. 6 in. below surface	158° F.	—	—
Temp. 10 in. below surface	164° F.	—	160° F.

From the above temperature records it will be seen that at no great depth from the surface of the manure piles the heat was too great to permit the existence of the larvæ, and this fact was supported by observation. On the top of the pile the larvæ were only living in the surface layer, that is, the habitat was *peripheral* and the excessive internal heat due to fermentation becomes practically a larvicide.

It is evident that in a well-packed manure heap, I am not speaking of small or loosely piled heaps, that only the peripheral region is infested by the house-fly larvæ, and that they do not, as a rule, penetrate deep into the central regions. In loosely piled heaps it would be possible for them to penetrate more deeply. The cooling of the whole heap might conceivably permit the deeper penetration of subsequent broods, but against this should be set the fact that the outside region

of the heap has by this time become less attractive to the flies owing to exposure and the fact that larvæ have already worked over it.

Reference was made earlier in the paper, in discussing the relative merits of counts of larvæ or of flies emerging as standards of comparison in judging insecticide values, to the difficulty of obtaining a fair sample of a manure heap. This fact is emphasized by the foregoing observations. Further, calculations have been made of the number of flies which might be produced from larvæ in a manure pile of a given size based upon estimates of the number of larvæ occurring in a pound of manure. Such estimates are obviously far from accurate, and while it may be a good policy to impress the lay mind with potential dangers of a heap of stable refuse, we should not do so at the expense of veracity. I am ashamed to admit that our knowledge of the breeding habits of the house-fly in manure piled under various conditions is by no means as complete as it should be and it is very desirable that other workers should make observations on such habits as the conclusions may prove of no little value in aiding the agriculturalist in the problem of the control of breeding places. If the conclusions in regard to the peripheral breeding habits of the fly in well-piled manure are correct, the advantage of storing in concrete and wooden chambers receives material support.

Mr. L. O. Howard: Experiments have been carried on in Washington and New Orleans of a similar character to those given by Doctor Hewitt and I would like to ask Mr. W. D. Hunter if he will explain what has been done in this direction.

Mr. W. D. Hunter: This year Doctor Howard inaugurated a series of house-fly experiments in Washington, almost parallel with Doctor Hewitt's. They grew out of the idea that Doctor Howard had felt for several years that the whole subject of the treatment of the breeding places of the house-fly had not been sufficiently investigated. The same idea Doctor Hewitt has mentioned occurred to Doctor Howard, that is, the necessity for basing experiments upon consideration of the effect of applications on the manure. At that juncture Doctor Howard called upon the Bureau of Chemistry, and coöperative experiments were begun, the Bureau of Entomology looking after the entomological part of the work, and the Bureau of Chemistry to determine the effect of the different applications upon the chemical composition of the manure, and a bacteriologist was brought in at the same time to determine the activity of the bacteria of the manure. Without knowing, as far as I am aware, of the plans that Doctor Hewitt

was putting into operation in Canada, we devised a series of cages very similar to his. There was a double wall provided to prevent infestation by eggs that might be deposited on the outside by flies that would be attracted by the odor of the manure. The cages were supported on four legs about 6 inches high. Part of the apparatus was a galvanized iron pan, in which the seepage from the deposit could be collected for chemical examination.

Doctor Hewitt referred to the fact that in most of the experiments of this kind that have been performed only one of the two important series of observations had been made. In some cases the manure has been examined to determine the effect on the fly larvæ. In such cases the determination of the number of flies emerging was overlooked, and in the other case the number of flies emerging would be determined, and the effect on the larvæ would be overlooked. Consequently, in our series of experiments we took both of these factors into consideration. On one side of these cages a small opening was provided. Through that opening, from time to time, after the manure was placed in the cage, small samples were extracted. A portion of the samples was used by the chemist to determine the effect of the application, and at the same time the exact mortality of house-flies was determined. These observations were made in more or less extensive series, so that the results could be averaged, and at least an approximately true index of the situation obtained. The number of adult flies emerging was watched in practically the same fashion as Doctor Hewitt's experiments. Wire fly-traps were placed on top, and the exact number was determined. We, therefore, had two methods of checking up the results; first, the actual examination of the larvæ in the manure to determine the mortality, and, second, the actual emergence of adults. We had the same difficulty that Doctor Hewitt encountered in obtaining a uniform infestation. We found no very satisfactory method of obivating that. We did what we could towards obviating it by mixing the material very well, exposing it first, then having it shovelled up, so as to approximate uniformity of infestation. I should say in this connection also that liberal allowance was made for control cages, that is, every time one of these series of experiments were started, three or more cages were used, in which the manure was not treated. In those cages the same examinations were made as to deaths and flies emerging. In that way, allowance was made for the normal mortality in the manure.

We had planned to use all of the substances that had been recommended for fly control, and any others, that might be suggested by the chemist. We used salt, borax, copper sulphate, iron sulphate, a number of proprietary substances, creosote, etc. The series of experi-

ments were so interesting, and the results so definite that, as the fly season was drawing to a close, Doctor Howard and Doctor Alsberg arranged to transfer the whole work to the City of New Orleans, where the flies would be active for perhaps two months longer. Certain series of experiments were repeated in the hope that results would become so definite that something could be published and used throughout the country at the beginning of the next fly season. Doctor Cook, of the Bureau of Chemistry, and Mr. Hutchinson, my associate, have just completed that second series of experiments in New Orleans. Mr. Hutchinson is here today. In a very short time we expect to place the results on record.

In connection with this investigation we undertook to work out some of the points in the life history of the fly, on which our information has been very meagre, as has been pointed out by Doctor Hewitt in his noteworthy work on the house-fly and Doctor Howard in his recent book. One of these points particularly was the duration of the period between the emergence of the adult flies and their attaining sexual maturity, that is, the pre-oviposition period. I think all the members of the Association are familiar with the basis of the so-called Hodge plan of controlling flies. In brief, Doctor Hodge's plan is to ignore, at least in a large part, the breeding of flies in stable manure, and devote the attack against the adults. That is the result of some experiments performed some years ago by Doctor Hewitt. He found the pre-oviposition period ran as high as ten to fifteen days. During that time there was no danger of depositing eggs, but the adult flies are going about getting food.

We were very much interested in getting complete data. Mr. Hutchinson would take a number of flies, place them in a jar with some food material that would be suitable, and would leave them in a certain cage for 24 hours. Then they would be taken out and the cage recovered, and observations made later as to whether any eggs had been deposited or any larvæ could be found. In a second cage the flies remained there 48 hours, and so on up to an indefinite number of 24-hour periods. In this way we hoped by the repetition of the experiments to obtain absolutely accurate information on this point. The results have not been assembled completely at this time, but the indications are very plainly that this pre-oviposition period is much shorter than the preliminary experiments of Doctor Hewitt had indicated. This emphasizes the importance of the point brought out by Doctor Hewitt—the absolute importance of directing efforts against the place where they might be breeding.

Just one other point. Doctor Headlee and Doctor Hewitt have both referred to the limited distribution of the fly larvæ in the piles of

manure. In connection with this series of experiments at the Arlington farm, Mr. Hutchinson was astonished one day to find that a large number of his larvæ were escaping. He began to investigate the matter. By examining many piles of manure near Washington he found a concentration of larvæ and pupæ in the peripheral ring near the outer surface. Immediately he considered the factors of moisture and temperature, that might be instrumental in bringing about this condition. The result of the observations of Mr. Hutchinson led him to the belief that moisture is more important than temperature. In fact, he has performed a series of experiments, in which he has regulated practically the location of the pupæ by the administration of water. This led to one point, that may be of great importance. He has found that, where the manure piles are completely saturated with water, the larvæ will make their way outside. The instinct of the larvæ is to obtain a location where there is an optimum of conditions and where the adults can make their exit. A practical application in a stable would be to throw the manure upon a frame work and keep it saturated with water. By that system the experiments show the larvæ will all fall through the bottom to the floor. In the case of a cement floor, it would be possible to flush them into the drain or dispose of them some other way. On a farm the manure might be placed on a platform and the larvæ forced by the application of water to make their way out to be eaten by the chickens.

I would like to congratulate Doctor Hewitt on this very important work that he has done. I think that all the members of the Association think that the high standard, that he set, when he wrote the book on the house-fly, has been maintained by the series of practical experiments, which he has described this morning.

MR. C. GORDON HEWITT: A number of years ago when I carried on house-fly work, I was able to devote all my time to it. Now it is possible for me to carry it on only during spare time. I would urge Doctor Howard and his associates to continue to carry on these experiments as they are very important. With regard to the pre-oviposition period, the single series of experiments which I carried on in Manchester, England, gave but few results and were not intended to do more than to give general information. The mean temperature in Manchester, England, is much less than in this country, consequently the pre-oviposition period there would be longer.

In the experiments which I mentioned in my paper I found that flies were emerging on the outside of the wooden cages before the cheese-cloth bottom was attached. During the hot days the newly emerged flies crawled up on the outside of the cages and the males copulated with the females immediately. This shows that the female fly may

become fertilized very soon after emergence. In regard to the suggestion made by Mr. Hunter as to watering manure in stables, it would appear to me that this would have the disadvantage of decreasing the manurial value. We must be very careful about advising farmers to adopt a suggestion of this kind, for such a process would result in the loss by leaching of the soluble plant food in the manure.

MR. Z. P. METCALF: The town of Asheville, N. C., was one of the first to take up active work against the house-fly and is one of the few towns in the South that is continuing the work. The Board of Health required that manure be placed in tight receptacles and damped very slightly. While Asheville is not a flyless town, it is very much better in this respect than most towns of its size in the South.

PRESIDENT P. J. PARROTT: We will now listen to a paper by Prof. S. J. Hunter, entitled

THE SANDFLY AND PELLAGRA, III[1]

By S. J. HUNTER, *University of Kansas, Lawrence*

SUMMARY OF PROGRESS

The work of obtaining evidence which would either confirm or refute the Sambon theory was continued this year under a special fund furnished by the Board of Educational Administration. The responsibility for the entomological side of the question rests with the author and the pathological side as manifested by the monkeys subjected to the bite of the sandfly rests with Dean Crumbine of the Medical School.

In this connection it may properly be noted here that since the publication of the last paper Harris has published an account of his results in producing pellagra experimentally in monkeys. Based upon his experiments, then, the monkey becomes a susceptible animal.

The two most important additions to our studies are fixed on the feeding habits and morphology of the mouth parts of *Simulium vitattum*.

Heretofore, we experienced little difficulty in encouraging the sandfly to bite the patient but no extended attention had been given to the biting habits in nature.

Last August, owing to the limited water supply in the principle sandfly inhabited brooks, this part of the study was transferred to Madison River in southern Montana where all stages of the fly were equally abundant. Here it was observed that the fly would bite the exposed parts and was more active on cool days while the temperature was below 70° F.

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[1] For papers I and II see this journal, Vol. V, No. 1, Feb., 1912, pp. 61–63, and Vol. VI, No. 1, Feb., 1913, pp. 96–101.

Of special importance was the observation made by four members of the party that the bite of the fly was not always noticeable. For example, the writer sat through an entire evening meal in the tent with the sandfly biting on the face near the base of the nose. He was not aware of its presence there until informed at the close of the meal by his companions regarding the length of the time it had been there. The spot, reddened in this case, and was about the size of a flax seed.

It seems probable also that it succeeds in attaching itself to the host through its mouth-parts because, when once settled down to feeding, it sticks to the host and is not readily detached.

Biting is not uniformly painless as sometimes the insect would be detected by its first contact.

Regarding the morphology, Mr. W. T. Emery, who has been my graduate student assistant in this work, has a paper now in press dealing with that phase of the subject.

A second point to be here recorded is that the monkey, which was used all last year to receive inoculations from the sandfly and which received its last inoculation on December 22, 1912, as recorded in my previous paper, late in November last year began to show a marked stomatitis accompanied by a diarrhœa. She has continued to lose in weight and the color of the face is changing from the normal to a pale ashy gray.

This is simply a report of progress, and as the author views it, does not warrant any conclusion for or against the Sambon theory.

NOTES ON THE BIOLOGY OF DIPLAZON LAETATORIUS (FABR.)

By E. O. G. Kelly, *Bureau of Entomology, United States Department of Agriculture*

The published rearing of *Diplazon* (*Bassus*) *lætatorius* from *Syrphus* puparia are few. Ratzeburg mentions having reared it from *Syrphus balteatus* in 1848 (Ichneumon d. Forstinsect.). Mr. G. C. Davis also described the species in *Transactions American Entomological Society*, Vol. XXII, 1884, and following his description, he states that it is one of the most common and wide-spread species in Europe and America. Mr. Bignell, in *The Entomologist*, Vol. XVII, 1884, states: "On 3d of June, I bred this Ichneumon from a *Syrphus* larva, obtained last October in Oreston quarry, feeding on *Aphis jacobeæ*. By end of October it had changed to pupa and remained that way till above date." It is figured in the *Agricultural Journal of South Africa*, Vol. 6, No. 3.

Sept., 1913, with a legend underneath, stating that it was parasitic on Syrphids, no mention of it being made in the text.

In Kirchner's catalog of *Hymenoptera*, page 84, is recorded a note by Herr Tischkin that he reared *Diplazon lætatorius* from the larvæ of *Adimonia rustica* (a small Chrysomelid). In Ann. Ent. Soc. France for 1877, page 408, Giraud and Laboulbene record rearing *Diplazon* (*Bassus*) *lætatorius* from *Syrphus balteatus*.

Dr. F. H. Chittenden notes in circular 43, second edition, page 5: "The efficiency of the *Syrphus* flies is greatly impaired by the presence of a Braconid parasite (*Diplazon lætatorius*) which is sometimes very prevalent, almost exterminating its host in many fields." Doctor Chittenden told the writer that the species had occurred to him to be one of the very commonest insects and had thus escaped being published by him.

This species was reared from puparium of *Allograpta obliqua*, the larvæ of which were collected by Prof. F. M. Webster at Clymers Ind., May 17, 1886, and sent to Washington, and the same observer also reared *Diplazon sycophanta* from Syrphid puparia at Battleground, Ind., in 1889. It has been reared from Syrphid puparia on several occasions during recent years by members of the Bureau of Entomology, United States Department of Agriculture. Mr. V. L. Wildermuth reared adults from puparia at Yuma, Ariz. In a note on this species he mentions collecting three Syrphid larvæ, on April 23, 1912, feeding on *Aphis maidis*. They pupated April 24, 26 and 27, from these puparia adult *Diplazon lætatorius* issued on May 7, 9 and 12. Mr. H. O. Marsh reared adults from puparia of *Syrphus* sp. at Garden Grove, Calif., from *Allograpta fracta* and *Eupeodes volucris* at Brownsville, Tex. Mr. A. Willis reared adults from puparia of *Syrphus americanus* at Ottawa, Kan., and the writer has reared adults from puparia of *Baccha clavata*, *Mesogramma polita* and *Syrphus americanus* at Wellington, Kan. Messrs. Marsh and Smyth noted adults swarming about cabbage heavily infested with *Aphis brassicæ* at Brownsville, Tex.

On 14th of May, 1909, the writer, to his great surprise, observed the adult female of *Diplazon lætatorius* ovipositing in eggs of *Baccha clavata*. He never had supposed it possible that an Ichneumon would lay its egg in the egg of another insect, and especially in this instance, for the adult *Diplazon* measures 8 mm. in length, and the Syrphid egg not more than 1 mm. The *Diplazon* female crawls astride the Syrphid egg and thrusts her ovipositor in the egg in a similar manner to that of *Aphidius testaceipes* which is figured in U. S. Dept. Agri., Bu. Ent. Bul. 110, page 105. However, from these Syrphid eggs, young Syrphid larvæ issued and grew to maturity, feeding on *Aphis medicaginis*.

They pupated June 9 to 14, and, again to the observer's surprise, adult *Diplazon lætatorius* issued June 24 to July 1, requiring about thirty-five days for development from egg to adult.

On May 24, 1912, the writer reared several adult *Diplazon lætatorius* of both sexes from puparia of *Syrphus americanus*. Two females from this lot were confined in a cage with a Black locust twig on which were ten Syrphid eggs among a lot of *Aphis medicaginis*. They sought out the Syrphid eggs at once and oviposited in each of them and in some of them the second time. The Syrphid eggs hatched May 26 and larvæ began feeding on aphids. They were nearly full grown on June 12 when it became necessary for the writer to be absent from the laboratory. On returning June 30, there were two *Mesograpta polita* and six *Diplazon lætatorius* in the cage. Mr. Irving Crawford while working under the direction of the writer at Wellington, Kans., reared four *Diplazon lætatorius* from puparia of *Baccha clavata*. Ten *Baccha clavata* larvæ, of unknown age, were collected on September 13, 1912; seven of them pupated on September 15; two adult *Baccha clavata* issued on September 25 and four *Diplazon lætatorius* issued on October 9. These data indicate that *Diplazon lætatorius* requires about ten days longer to mature than its host.

Messrs. W. D. Pierce and T. E. Holloway have described a similarly complicated life-history of *Chelonus texanus*, JOURNAL ECONOMIC ENTOMOLOGY, Vol. 5, No. 6; stating in brief that *Chelonus* deposits her egg in the egg of the host, but the parasite emerges not from the egg but from the larva developed therefrom.

Messrs. T. H. Parks, W. R. McConnell and R. A. Vickery of this Bureau observed this peculiar habit of *Chelonus texanus* in the summer and fall of 1912, the former rearing the species through two generations in *Laphygma frugiperda*, each of which required but twenty-one days, the hosts in this case developing in twenty-four days.

Mr. Parks and the writer reared great numbers of this same parasite from larvæ of *Loxostege similalis* in the vicinity of Wellington, Kans., in fall of 1909, during a severe outbreak of the latter species on alfalfa. The *Chelonus* then so completely overcame the *Loxostege* that by winter this pest was found only with great difficulty. In 1910, it was rarely found and in 1911, '12 and '13, it had not yet become abundant, which we have attributed to the effect of *Chelonus*.

Messrs. H. M. Russell and F. A. Johnston (JOURNAL ECONOMIC ENTOMOLOGY, Vol. 5, No. 6) relate a parallel case in the life-history of *Tetrastichus asparagi*. Given in brief, the adult *Tetrastichus* female oviposits in the egg of its host, the adults issuing from the mature larvæ. Doctor Marchal observed this same phenomenon [illegible] *Polygnotus minutus* in France with the added phenomenon of *Poly*[illegible] [illegible]

The writer observed *Polygnotus hiemalis* ovipositing in eggs of *Mayetiola destructor*, and reared adults of this parasite from the *Mayetiola destructor* puparium in the spring of 1908. Mr. Reeves of this Bureau is now engaged in a more exhaustive study of *Polygnotus hiemalis*.

It should also be stated in this connection that this same method of oviposition in the egg and the subsequent emergence of the adult parasite from the host larva occurs in *Ageniaspis* and *Litomastix*, with the added phenomenon of *Polyembryony*, as shown by Marchal and by Silvestri.

Thus there are now four families of *Hymenoptera*, in which certain forms have this method of parasitism: *Diplazon laetatorius* representing the *Ichneumonidæ*; *Polygnotus hiemalis* and *Polygnotus minutus* representing the *Proctotrypidæ*; *Chelonus texanus* representing the *Braconidæ*, and *Tetrastichus asparagi*, *Ageniaspis fuscicollis* and *Litomastix* (*Copidosoma*) *truncatellus* representing the *Chalcididæ*.

The writer first made these observations in spring of 1909, while working, alone, in Wellington, Kan., and could get no corroborative evidence, other than the reared specimens. The matter was presented to Dr. L. O. Howard for publication the following December, but owing to lack of corroboration, it did not at that time appear advisable to publish the data.

Scientific Notes

The Clover Leaf Weevil (*Hypera punctata*), common in the eastern states, has recently become abundant in a section of the Payette Valley in southwestern Idaho. A field of red clover was eaten to the ground and surrounding alfalfa seriously injured during April by the larvæ of this insect. The clover and some of the alfalfa were promptly plowed under to kill the larvæ.

The infested field of red clover is situated along the right of way of a branch line of the Oregon Short Line railroad which was constructed three years ago. Specimens of the insect can now be found in red clover and alfalfa fields extending for a distance of twelve miles up and down the valley, though little damage has yet been done except in two or three places.

There is no evidence of the presence of the fungus, *Empusa sphaerosperma* Fres, which effectively controls outbreaks of this insect east of the Mississippi River, and some of this material, secured through the Section of Cereal and Forage Crop Insects of the Bureau of Entomology, has been recently introduced into the Payette Valley in an effort to establish it there.

This is the first instance of the occurrence of this insect in injurious numbers in the inter-mountain country and some anxiety is felt on account of the dry climate being unfavorable to the rapid spread of the fungus which controls the pest in the

T. H. Parks,
University of Idaho.

Economic Entomology Abroad. It is interesting to note that the example of the economic entomologists of the United States, in forming an Association of Economic Entomologists, is being followed by other countries. Dr. K. Escherich, after his visit to America in the summer of 1911, read a paper before the German Association of Zoölogists on "Economic Entomology in the United States." He followed this by the publication of his book with the same title in 1913, and in the summer of 1913, after preliminary correspondence, the first meeting of the German Association of Economic Entomologists was held at Würzburg under the presidency of Doctor Escherich. His address was on the general subject of economic entomology. Doctor Rübsamen read a paper on the eradication of the Phylloxera in Prussia. Doctor Heymons, of Berlin, spoke concerning the entomological institutions of Italy and the work accomplished in that country in economic entomology. Dr. L. Reh, of Hamburg, discussed entomological conditions in Germany. Doctor Aulman spoke of economic entomology in the German colonies. Fostrath Orth described the ... Phylloxera work in Germany. Doctor Bolle of Goritzia, Austria, gave an illustrated lecture on the work of insects in libraries and also read a paper on the good work of *Prospaltella berlesei* versus *Aulacaspis pentagona* in South Austria. Doctor Zander, of Erlangen, read a report on apiculture. Doctor Teichman, of Frankfort, discussed the tsetse fly. Doctor Schulze, of Berlin, spoke of the wild silkworms of South Africa and their practical use. Doctor Börner gave the bionomics of *Phylloxera pervastatrix*. Forstassessor Hænel read a paper on the protection of birds and of the service of birds in the fight against injurious insects. Doctor Prell, of Tübingen, presented a paper on Tachinid flies. Doctor Jablonowski, of Budapest, spoke of *Tapinostola musculosa* and its damage to wheat.

Much was said about the good work of the American Association of Economic Entomologists, and Dr. L. O. Howard was elected the first honorary member of the newly founded association.

Contemporaneously, an Association of Economic Entomologists of Russia has been founded, and its first meeting was held at Kieff last autumn. This was the organization meeting, and the next meeting is called for October, 1914, also in Kieff. The details of the organization meeting and of the officers elected have not yet been received.

The Canadian Entomological Service. Thirty years ago, in 1884, the Canadian Government appointed a dominion entomologist to advise agriculturists and others regarding the control of insect pests. Two years later, on the establishment of the Experimental Farms system, Dr. James Fletcher, who occupied the position, was attached to the new branch of the Department of Agriculture in the joint capacity of entomologist and botanist, which position he occupied with conspicuous success until his death in 1908. The growth in importance of the subjects necessitated their separation and accordingly Divisions of Entomology and Botany were created. Dr. C. Gordon Hewitt was appointed dominion entomologist in 1909 and entrusted with the work of organizing the new Division of Entomology of the Experimental Farms Branch of the Department of Agriculture with offices and laboratory at the Central Experimental Farm, Ottawa.

The urgent need of legislation, in order to permit action to be taken to prevent the introduction into Canada and spread within the country of serious insect pests and plant diseases, was responsible for the passage of the Destructive Insect and Pest Act in 1910. The still greater need of investigations on the insect pests affecting agriculture, forestry and other branches of human activity has led to the establishment of field or regional laboratories in different parts of Canada with trained entomologists in charge to study local problems.

Owing to the consequent expansion of the entomological work along investigatory and administrative lines and the fact that such work did not constitute a necessary part of the work of the Experimental Farms system and executively was virtually separate, the Entomological Service has now been separated from the Experimental Farms Branch and has been constituted an independent Branch of the Department of Agriculture under the direction of the dominion entomologist. It is proposed to erect a building to provide offices and laboratories for the new Entomological Branch. Will correspondents kindly note that all official communications and publications should be addressed to "The Dominion Entomologist, Department of Agriculture, Ottawa."

This reorganization, which will also include the establishment of a national collection of the insects of Canada in the Canadian National Museum (the Victoria Memorial Museum) at Ottawa under the care of the dominion entomologist, marks an important step in Canadian entomology. It will result in a still greater development of the study of Canadian insects along scientific and practical lines.

An Unusual Occurrence of Walking-sticks. During the past summer (1913) the woods in the vicinity of Peterson, Iowa, showed walking sticks, *Diapheromera femorata*, in numbers which constituted a veritable pest. The woods are principally oak, with smaller numbers of elm, ash, aspen, linden, hickory and black walnut trees and a heavy undergrowth of hazel. On the 30th of May it was observed that the hazel bushes were quite covered with recently hatched walking-sticks, varying from three or four millimetres to a centimetre in length, in color they were a very pale yellowish green.

By the first of August they had begun to leave the timber and appear in the orchard and around the house. In the orchard they infested particularly one tree of early apples, devouring nearly all the leaves; on a single twig six inches in length I counted seven clustered together and they were equally numerous over the entire tree.

The woods had become forbidden ground to us; if one were sufficiently brave to start through them, the walking-sticks fell to the ground from every tree in such numbers as to sound like hail. Through August and September there were seldom fewer than fifty on our screen door each morning. The little chickens were particularly enthusiastic over them and soon learned to appear when we swept them off the doors in the morning. In spite of the long awkward bodies and clinging legs of the insects, they were soon able to devour them quickly and deftly.

By mid-September the timber showed stretches a couple of hundred feet broad and a mile long where the trees had been completely defoliated. The walking sticks began to cross the road to another piece of timber in which there had been almost none of the insects and every passing carriage or motor crushed them by hundreds. This extremely local character of the infestation was a curious feature. One piece of timber containing about two hundred acres was almost wholly stripped, while a similar piece across the road was scarcely touched. It would appear that no walking-sticks matured there, and the slight damage done was by migrants from the other timber. There was an apparent disparity in numbers between the males and the females, though the apparent scarcity of females may be due to their greater sluggishness. During the latter part of the season the females appeared in slightly greater numbers.

HORTENSE BUTLER.
State College, N. M.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

JUNE, 1914

The editors will thankfully receive news items and other matter likely to be of [illegible] scribers. Papers will be published, so far as possible, in the order of reception. All [illegible] butions, at least, should be in the hands of the editor the first of the month preceding [illegible] Contributors are requested to supply electrotypes for the larger illustrations so far as [illegible] receipt of all papers will be acknowledged.—Eds.

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This issue completes the proceedings of the Atlanta meeting exc[illegible] the papers read by title. The latter will appear in the August num[illegible] Other papers will be published as rapidly as space limitations per[illegible]

There is a solidarity among editors, doubtless due to a simila[illegible] in their problems and perplexities, and we find much of truth in [illegible] editorial indited by a brother in Philadelphia and appearing in [illegible] April number of Entomological News. We commend the paragra[illegible] to the attention of our readers and take this opportunity to expre[illegible] the hope that future contributors to this Journal will bear in mi[illegible] the principles firmly but gently stated by our contemporary. [illegible] regard for the rights and privileges of others helps amazingly in avoi[illegible] unnecessary friction.

The advance in medical entomology and the economic import[illegible] of the Diptera are well shown in this issue. The articles on the [illegible] fly and its control and the discussion of the magnificent work again[illegible] mosquitoes in New Jersey are not only timely but should be referre[illegible] to by every entomologist who would keep posted along these lines. We are only at the beginning of a comparatively unknown and [illegible] worked field fraught with great potentialities. There is much yet [illegible] be done in working out the life-histories of economic spe[illegible] particularly in learning those practical details essential to their control. Much of this work should be done in close coöper[illegible] the medical investigator in order to secure the best results with [illegible] least loss of effort. It is a pleasure to note that two import[illegible] works on disease-carrying insects have recently been publishe[illegible] The[illegible] to be reviewed shortly, give a comprehensive idea of their [illegible] fields and will prove of great service to those engaged in sim[illegible] of work.

Current Notes

Conducted by the Associate Editor

Dr. Paul S. Welch, instructor in entomology, Kansas State Agricultural College, [illegible] advanced in rank to assistant professor.

Mr. A. C. Morgan, of the Bureau of Entomology, returned to his field station at [illegible], Tenn., on March 25.

Professor O. H. Johannsen has been promoted to a full professorship in entomology in Cornell University.

Mr. Joseph S. Obeeny has been appointed field assistant in entomology, at the Agricultural Experiment Station, New Brunswick, N. J.

[illegible] C. Loftin of the Bureau of Entomology, has returned to New Orleans after several months spent in Brownsville, Texas, in the study of sugar cane insects.

At the meeting of the American Philosophical Society at Philadelphia, April 25, Mr. Alfred Goldsborough Mayer, of Washington, D. C., was elected a member.

Professor P. J. Parrott, Entomologist of the Experiment Station, Geneva, N. Y., [illegible] commenced work again, having fully recovered from a serious illness of several weeks.

Dr. W. D. Hunter, of the Bureau of Entomology, left on March 23, for a short [illegible] inspection of the Rocky Mountain spotted-fever tick work in the Bitter Root [illegible] of Montana.

Mr. W. B. Wood, of the Bureau of Entomology, has returned to Washington after [illegible] several weeks in California, where he was assisting in the work for the con[illegible] the pear thrips.

Mr. A. H. Jennings, of the Bureau of Entomology, will resume his work on pellagra [illegible] Spartanburg, S. C., in connection with the Thompson-McFadden Pellagra Com[illegible] about May 1.

Mr. William H. White, B.S., Maryland Agricultural College, has been appointed [illegible] Assistant, Bureau of Entomology, and assigned to work on truck-crop [illegible] Maryland.

M[illegible] G. A. Root and J. E. Hutson, graduate students at the Massachusetts [illegible] College, are serving temporarily as nursery inspectors for the State [illegible] Agriculture.

M[illegible] Mokshetsky has been appointed director of the Pomological Experiment [illegible] which has been recently established in the town of Simferopol, Crimea,

D[illegible] O. Howard has been elected an honorary member of the new German [illegible] of Economic Entomologists, which held its first meeting at Madgeburg [illegible] 1913.

Mr. H. H. Lyman and his wife, of Montreal, we are informed, were passengers on the ill-fated *Empress of Ireland* and it is feared that they were among the [illegible]

Mr. M. P. Zappe, a graduate of the Connecticut Agricultural College will be employed during the summer as assistant in the entomological department of the Agricultural Experiment Station at New Haven.

Mr. Thomas H. Jones, Collaborator of the Bureau of Entomology, stationed at Rio Piedras, Porto Rico, has been visiting Washington for study and perusal of literature, and the identification of specimens.

Mr. L. S. McLaine, who has charge of the brown-tail moth work in the Province of New Brunswick, Canada, will be stationed at the Parasite Laboratory, Melrose Highlands, Mass., for the next four months.

Mr. Don Whelan, a graduate student of the Kansas State Agricultural College has received a fellowship in the Graduate School of Ohio University, where he will continue his work in entomology.

The allowance made to the Department of Entomology, Ohio Agricultural Experiment Station, for all purposes, salaries and running expenses from February 16, 1914, to February 15, 1915, is $11,633.07.

Mr. Herman H. Brehme has resigned as mosquito drainage inspector, Agricultural Experiment Station, New Brunswick, N. J., and is now manager of the New Jersey Entomological Company of Newark, N. J.

Messrs. H. G. Ingerson and H. K. Plank, graduates of the Pennsylvania State College, have been appointed as scientific assistants in the Bureau of Entomology, their work beginning April 18, 1914.

Mr. B. R. Coad, of the Bureau of Entomology, left Washington on April 1 for Arizona, where he will remain during the season to study the relations between *Tharberia* insects and cotton culture. His address will be Tucson, Ariz.

Mr. C. C. Hamilton, a graduate student assistant of the Department of Entomology, Kansas State Agricultural College, has received a fellowship in the Graduate School of the University of Illinois, where he will continue his work in entomology.

Mr. Ralph R. Parker, 1912, Massachusetts Agricultural College, and a graduate student there, has accepted for the summer, an appointment in Montana to investigate conditions in connection with the house fly and its relation to the spread of diseases.

Mr. G. N. Wolcott, of the Porto Rican Board of Agriculture, visited Washington, D. C., March 27. He will spend the spring months in Illinois collecting [illegible] parasites for introduction into Porto Rico. He will spend the summer in Europe on leave.

Messrs. Arthur J. Ackerman and Daniel G. Tower have finished their work for the degree of Master of Science at the Massachusetts Agricultural College, and are now engaged in inspecting nursery stock for the State Board of Agriculture, with headquarters at Boston.

Mr. J. L. King, who has been completing his course at the Ohio State University, receives his Bachelor's degree in June and will resume work with the Ohio Station in late June, going to his laboratory at Gypsum.

Mr. R. H. Hutchinson, of the Bureau of Entomology, left on March 22 for New Orleans, where he will conduct further investigations of the treatment of manure bins in the control of the house fly, in coöperation with the Bureaus of Chemistry and Plant Industry.

Mr. William P. Hayes, a graduate of the Kansas State Agricultural College, has been appointed assistant in entomology at the Kansas Agricultural Experiment Station, and is now stationed in the southern part of the state on the state crop pest investigations.

Mr. Fred A. Johnston, entomological assistant in the Bureau of Entomology, who has been in Washington, D. C., for consultation and bibliographical and scientific work, has returned to Riverhead, Long Island, where he is engaged in investigation of insects affecting potatoes, cauliflower, asparagus, and other truck crops.

Mr. E. H. Siegler, of the Bureau of Entomology, has left California, where he was assisting in the work for the control of the pear thrips, returning to the station at Benton Harbor, Mich., for the purpose of carrying on experiments with insecticides against orchard insects.

Mr. John E. Graf, Scientific Assistant, Bureau of Entomology, who has been in Washington during portions of January, February and March for consultation and study, has returned to his permanent quarters at Whittier, Calif., to resume work on the sugar-beet wireworm, potato-tuber moth and other insects affecting vegetable and truck crops.

Mr. H. O. Marsh, Scientific Assistant, Bureau of Entomology, after an absence of a few months, during which he took a special course at the Kansas Agricultural College, Manhattan, Kansas, has returned to his headquarters at Rocky Ford, Colo., where he will continue investigations on insects affecting sugar beets and truck crops.

Mr. R. S. Woglum, of the Bureau of Entomology, has returned to Whittier, Calif., to continue his work with hydrocyanic-acid gas and the special citrus insects of that region. Mr. Arthur D. Borden, a graduate of Leland Stanford Junior University, and highly recommended by Professor Kellogg, has been employed and assigned to Mr. Woglum as a field assistant.

Mr. J. N. Summers, who has been conducting parasite investigations at the Gypsy Moth Laboratory for the past three years, will sail for Europe in April and will make observations on the fluctuations in increase of the gypsy moth in German forests, and collect and ship parasites to the Gypsy Moth Laboratory for colonization in this country.

Mr. Alfred E. Cameron, Government Scholar of the Board of Agriculture, England, has recently arrived in the United States from the Department of Agricultural Entomology of the Victoria University of Manchester. Mr. Cameron is to spend the summer and autumn working under Dr. T. J. Headlee at the Entomological Department of the New Jersey Agricultural Experiment Station, New Brunswick, N. J.

A laboratory has been established in Winchester, Va., by the Bureau of Entomology, for conducting studies in the life-history and methods of control of the apple tree borer and orchard plant-lice. Mr. E. B. Blakeslee will be in charge of the work, assisted by Mr. B. R. Leach. Mr. Leach will give especial attention to remedies to be employed in the control of the woolly apple aphis.

Mr. S. S. Crossman, who was formerly engaged as an assistant on the citrus insect investigations in Florida, and has during the past two years been employed in Porto Rico investigating economic insects, as an assistant to the entomologist of the Board of Agriculture, Porto Rico, has been appointed as scientific assistant of the Bureau of Entomology, and will carry on investigations on parasites at the Gipsy Moth Laboratory.

According to the *Experiment Station Record* at the University of Manchester, Eng., "the new laboratory for research work in agricultural entomology was opened November 13, 1913, by Sir Sidney Oliver, permanent secretary of the Board of Agriculture and Fisheries. A laboratory room fifty-eight by twenty-eight feet is available, together with a smaller laboratory, an experimental field with greenhouses, etc. Dr. A. D. Imms, formerly forest entomologist of the government of India, has been appointed first reader in agricultural entomology and will conduct researches and supervise the work of research students."

Mr. James W. Chapman, who was granted a Doctor's degree by the Bussey Institution of Harvard University, and who for the past two years has been engaged as entomologist to the Park Department of the City of Boston, has been appointed as Scientific Assistant of the Bureau of Entomology and will take up experimental work with Mr. R. W. Glaser of that Bureau on the "wilt" disease affecting the gypsy moth. Mr. Chapman published some time ago a bulletin on the leopard moth, *Zeuzera pyrina*, and several other insect enemies of shade trees.

According to *Science* (issue of May 15) Prof. W. C. O'Kane, professor of economic entomology at the New Hampshire College, and Entomologist of the Station, has been elected professor of zoölogy and entomology at the Ohio State University, Columbus, Ohio, from which he graduated in the class of 1907. Professor O'Kane was appointed to his position in New Hampshire on the resignation of Prof. E. D. Sanderson in 1910, and was recently appointed deputy commissioner of agriculture in charge of the gypsy and brown-tail moth work of that state.

An exhaustive report on the destruction of the immature stages of the house fly in stable manure is about to be published. This is the result of coöperative work with the Bureau of Chemistry and Plant Industry in which particular attention was paid to the effects of various applications on the fertilizing value of the manure. This report will be published as a contribution from the Bureau of Entomology. (From *News Letter No. 2, Bureau of Entomology*.)

Since the promulgation of the quarantine against foreign cotton seed on account of the danger of introduction of *Gelechia gossypiella* and other pests, it has been found that a small amount of seed comes to this country in baled cotton from Egypt. J. L. Webb investigated this matter in New Bedford and Fall River, Massachusetts. It was found that the amount of seed brought in in the way of samples is small, but one live pink boll worm was discovered. The danger from this source is clear from the fact that considerable quantities of Egyptian cotton are shipped to the southern mills which, in many cases, are adjacent to cotton fields. (From *News Letter No. 2, Bureau of Entomology*.)

Mailed June 15, 1914.